Issued August 16, 1912.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—CIRCULAR No. 69.
MILTON WHITNEY Chief of Bureau.

SOILS OF THE EASTERN UNITED STATES AND THEIR USE—XL.

MARSH AND SWAMP.

BY

JAY A. BONSTEEL,
Scientist in Soil Survey.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1912.

BUREAU OF SOILS.

MILTON WHITNEY, *Chief of Bureau.*
ALBERT G. RICE, *Chief Clerk.*

SCIENTIFIC STAFF.

FRANK K. CAMERON, in charge of Physical and Chemical Investigations.
CURTIS F. MARBUT, in charge of Soil Survey.
OSWALD SCHREINER, in charge of Fertility Investigations.

SOILS OF THE EASTERN UNITED STATES AND THEIR USE—XL.

MARSH AND SWAMP.

In the soil classification of the Bureau of Soils the term "Swamp" is used to designate all areas which in their natural condition are too wet for the production of any crop. Such areas are usually covered with standing water for much or all of the time. Swamps are covered with a great variety of native vegetation, consisting chiefly of water-loving grasses, reeds, shrubs, and trees.

The word "Marsh" is used by contrast to designate low, wet, treeless areas, usually covered by standing water and supporting a growth of coarse grass and rushes. The Marsh is subdivided into two classes. The first of these is the Tidal marsh, where broad stretches of low-lying and practically treeless land along the coast are subjected to inundation by the rising tide. The other class consists of the fresh-water areas in the uplands or near the heads of tidewater estuaries where fresh water is backed up over the marshland by each rising tide.

During the progress of the soil-survey work there have been encountered 21,184 acres of Marsh, 588,544 acres of Tidal marsh, and 1,745,512 acres of Swamp. This constitutes a total acreage of 2,355,240 acres of all classes of swamp land. It is probable that a total area of approximately 60 million acres of these undrained lands exist in the eastern part of the United States in addition to approximately 15 million acres of Meadow, which occurs in swampy positions along streams.

CONTRAST WITH OTHER TYPES.

The areas of Marsh and Swamp might possibly be confused with Meadow. They differ from Meadow, however, in that they are either permanently wet or are covered intermittently by the tide. By contrast the areas of Meadow, which lie chiefly along alluvial flood plains, are subject to inundation at indefinite intervals. The meadowlands are usually overflowed with the annual rise of the streams which they adjoin. The Marsh and Swamp, however, almost always consist of areas where water accumulates either through the more or less permanent obstruction of drainage channels or through the seepage of water from higher lying areas.

50683°—12

In view of these distinctions it is readily seen why Meadow is frequently occupied even in its natural condition for some agricultural uses, while, on the other hand, the Marsh and Swamp in their natural condition may only be used for grazing of the natural grasses which may grow upon them, while tilled crops may be grown only when artificial drainage has been installed.

CHARACTERISTICS OF SOIL AND SUBSOIL.

The actual surface material comprising the soils of Marsh and Swamp varies with the different areas and in the different portions of the same area. In the case of the majority of areas of Marsh occurring upon the uplands, the soil to a depth of 2 inches to several feet is a mass of partly decayed organic matter, thoroughly saturated with water. Underneath this is found a subsoil material consisting frequently of compact claylike material in the deeper and more centrally located portions of the area, or of sandy, gravelly, or stony loam material near the borders, particularly in the glaciated region. The subsoil material universally is somewhat similar to the mineral matter of the upland soils. It is usually gray, ash colored, or blue, through the lack of drainage and oxidation, which gives characteristic color to well-drained upland soil. Even within narrow limits the surface soil or the subsoil may change rapidly in characteristics in all areas of Marsh.

In the case of Tidal marsh there is usually not so great a variation either in the surface or subsoil material. In the majority of cases the surface soil consists of a matted, partly decayed mass of eelgrass turf and roots, through which the living roots of growing eelgrass penetrate. This material is usually filled with a gray or drab silt or silty clay and constitutes a mingled mass of partly living and partly dead organic matter, well filled with finely divided mineral matter. This material grades downward into soft slimy mud or clay, which constitutes the main part of the subsoil. In some instances where the Tidal marsh lies to the leeward of sand dunes or coastal beaches the wind has carried fine or medium sand out upon the surface of the marsh to considerable distances, and in such cases both the surface soil and the subsoil are usually a sandy loam. In all instances the Tidal marsh is subject to inundation by brackish or salt water with each rising tide.

Similarly there may be a considerable variation in the character of the surface soil and subsoil of Swamp. In almost all cases the surface soil is well filled with partially decayed organic matter, consisting of the dead and decaying undergrowth, the leaves, branches, and even trunks of trees which have grown upon the Swamp, and other organic matter which has been formed from mosses and the minor growth found in such wet and cool places. This material is

mingled with different classes of mineral matter which may have been washed in from adjacent uplands or carried in by inundations of the streams which flow through the majority of such swampy areas. There is usually a considerable variation in the character and texture of the material found in different parts of the same area of Swamp. Usually, however, Marsh, Tidal marsh, and Swamp are all marked by considerable accumulation within the surface soil of organic matter in a partially decayed state.

LIMITATIONS IN USE.

In all cases the drainage of Marsh or Swamp is fundamentally necessary to the utilization of such lands for agriculture. In the case of Swamp clearing is also necessary.

The drainage of any particular area of Swamp or Marsh constitutes a separate engineering problem in itself. In the case of most of the upland, fresh-water Marsh it is not difficult to find drainage ways by which the surplus water may be removed. Frequently the mere straightening of the channels of streams that flow sluggishly through the area will serve to give a sufficient fall to remove the water from a considerable proportion of the land. In other cases it is necessary to remove barriers of earth or even of rock which have prevented the cutting down of the stream channel and the accomplishment of natural drainage. After the installation of the main drain, which should follow approximately the natural drainage lines of the region, it becomes necessary to drain still further the land through the installation of open ditches and of tile underdrains. In many instances it has been found necessary partially to accomplish the drainage of the land by digging open ditches for the removal of the surplus water before the installation of tile underdrains becomes practicable. This arises from the fact that the removal of the water from the surface soil and subsoil causes a considerable degree of shrinkage of this material, and if the tile drain were installed before a large part of this shrinkage had taken place, the tile lines would be disturbed and the drainage would be interrupted.

Wherever it is possible, in the drainage of Marsh, to cut through the surface mucky material into a harder underlying subsoil material, this preliminary precaution is not so necessary.

In many instances the clearing of areas of Swamp costs from $20 to $100 per acre in addition to the cost of drainage.

The reclamation of Tidal marsh involves difficulties in the way of engineering management that make such reclamation almost impossible to the individual upon a small scale. In consequence, every project for which reclamation plans are to be made should be placed in the hands of a competent engineer. It is wise to make a study of the probable agricultural value of the land when reclaimed. This

value will vary greatly with the different areas; in the case of many well located with respect to city markets, or to transportation to large markets, intensive crops may be grown, and a greater expense in the reclamation of such areas would be justified than in the case of others more remotely situated. Again, the interval between high and low tide constitutes a dominating factor in the reclamation of many tide marshes. Unless there is a sufficient interval to permit of the draining away of the fresh water which flows into the marsh, it would be difficult to reduce the water table low enough within the reclaimed area to permit of the production of agricultural crops. The shoreline configuration, which determines the amount of embankment necessary to shut out tidewater, is also an important factor. The exposure to storm winds and to the waves during heavy storms also constitute factors which must be considered in estimating the strength and size of embankment and the necessity for rock facing or for other provision for additional security. It is therefore apparent that when the reclamation of Tidal marsh is considered one of the first requisites will be to study carefully the engineering features of embankment, ditching, and the installation of underdrains.[1]

It has been found from the study of many instances that the cost of reclamation of Tidal marsh will range from a few dollars to as high as $50 or $60 per acre in case of the construction of extensive works. This expenditure, however, is amply justified even when only general farm crops like corn, the small grains, and grass are produced, since the marshlands when once drained and free from any excess of saline matter, are unusually productive. Acreage returns amounting to $150 or even $250 may be secured from the production of market garden vegetables and small fruits upon reclaimed Tidal marsh.

There are thousands of acres of unclaimed Tidal marsh along the coast line of the eastern portion of the United States which remain unoccupied for any agricultural purpose and which still constitute a menace to the health of the communities to which they are adjacent. From both the standpoint of agricultural utilization and of sanitation a study should be made of the possibility of the reclamation of these marshes.

Even with the high cost of drainage and clearing it is frequently desirable to reclaim considerable areas of Swamp. The improvement in sanitary conditions of the neighborhood should be taken into consideration in taking up such work, but usually the agricultural returns to be obtained from the drained land must be depended upon to justify reclamation. The soils classed as Swamp vary considerably in their characteristics, as has been already pointed out, and consequently they show a considerable variation in the class of crops to

[1] For further discussion of tidal marshes and their reclamation consult Bulletin 240 of the Office of Experiment Stations, U. S. Dept. Agr.

which they are best suited. It is therefore necessary to make a careful determination of the character of soil and subsoil material in each area, and of the possibility of raising intensively farmed or extensively farmed crops upon the lands when freed from surplus water. The position of the Swamp with respect to climate, and particularly with regard to transportation facilities to market, will control to a large degree the amount of profit per acre which may be anticipated from the land. Upon peaty or mucky swamp soils, where such intensively farmed crops as cabbage, onions, celery, peppermint, or cranberries may be produced a considerable outlay in the drainage and clearing of the Swamp may be profitably assumed. In other cases where corn or small grains may be grown, an intermediate amount of expenditure is justified, but in many cases the swamp land when drained and cleared will only be competent to produce grass for the cutting of hay or for grazing purposes. Under such circumstances a smaller expenditure per acre is justified than in either of the former cases. Even with a large expenditure the great fertility of the drained land and its high producing capacity for grass have given rise to fair profits from the reclamation of the lands. For the purpose of grazing or of hay cutting the returns per acre are usually sufficient to pay a good interest upon a total valuation of $75 to $100 per acre upon well managed areas.

It is thus apparent that with all classes of Marsh, Tidal marsh, and Swamp there are several factors which must be determined before the reclamation of any particular area is decided upon. The first of these will be the character of the soil over the reclaimed area and its adaptation to special and general farm crops. The second is the proximity to market or the transportation facilities, since the profits to be derived from the reclamation of the land will depend largely upon the sale price of the crops grown. The third point to be considered is that of the engineering feasibility of the drainage of the Swamp and the probable cost per acre of such drainage when completed. It is also necessary to consider the first cost of the land, and in this connection the probable rise in the land value, as a result of drainage, to be reckoned with the annual profit per acre in estimating the total profits to be derived from the drainage operation. It is also desirable to consider the sanitary relationship of drainage with respect to the general health of the community.

It has been found, in many cases, that the newly drained areas of Swamp are not capable of producing the best crops the first year or two after they have been drained and cleared. In those areas where the surface soil contains a large amount of partly decayed vegetable matter the application of considerable quantities of coarse stable manure has proven highly beneficial. It has also been found, both in the low-lying and swampy soils of the Atlantic seaboard and in

those of the glacial lake region of the north-central States, that the application of potash salts, particularly the muriate and kainit, has given profitable results with all crops except potatoes. With potatoes, it is usually considered best to use the sulphate of potash upon these and other soils.

Probably the best practice in the subjugation of such lands is to plow the surface vegetable mold in the fall, allow it to become well rotted during the fall and winter months and then, after a thorough harrowing, to prepare for a general farm crop like corn, cotton, cowpeas, or oats in more northern climates. After the production of such crops for a period of one or two years it is possible to make a more intensive use of the land for potatoes, cabbage, lettuce, celery, or other special crop.

In the more southern farm practice it has been found that the application of lime, either the burned lime at a rate of about 1 ton per acre or the ground limestone at the rate of 3 tons per acre, will give increases in crop yields which are decidedly profitable. In the case of the leguminous crops it is almost absolutely essential that raw swamp soils, high in organic matter, should be limed and that stable manure should be applied before any large crops may be expected.

THE USES OF SWAMP LAND.

In many places along the Atlantic seacoast considerable areas of Swamp have been ditched and reclaimed for agricultural use. Usually these lands are found in the Middle Atlantic section or in more southern localities. Several notable instances exist in the eastern part of North Carolina. These lands are nearly level. Their surface is broken only by low ridges which rise from 2 to 5 feet above the surrounding levels. The flat surface is frequently covered with water for the greater part of the year. The elevation of these pocosons ranges from 10 to 50 feet above sea level and there is usually opportunity for the drainage of the area by gravity. Large main ditches or canals are constructed from the center of the area to some large outlet stream. These ditches serve as the outlet for a large number of smaller open ditches. In some areas tile underdrainage is also installed between the smaller lateral ditches. The pocosons are usually timbered and the heavily timbered areas are those which are considered to have the greatest agricultural value. The surface soil usually consists of a black or brownish spongy mass of vegetable matter in various stages of decomposition. With this there is mingled different proportions of fine earth, usually silt or clay. The soil in its natural condition is filled with water, although during particularly dry seasons it may become so dried out at the surface as to burn. The subsoil is usually a clay or sandy clay not very differ-

ent from the surrounding upland soil types. This class of soil is usually considered more fertile and more lasting under cultivation than similar surface soils underlain by gray or whitish sand.

Wherever the timber has been cleared from these pocoson areas and the soil properly drained, aerated, and limed, yields of 35 to 75 bushels of corn are obtained in a fair season. The use of lime is considered absolutely essential to sweeten these soils before any crops may be grown upon them. In addition to corn, which is the staple crop upon these drained areas, cotton, hay, and late truck crops are produced in the Middle Atlantic States. In some parts of the country such soils are known to be well adapted to the production of celery, cabbage, onions, and lettuce. It has been discovered through experience that it is not well to plant lettuce or onions upon these soils when recently drained. The land should be cultivated to corn or cotton or some other crop for one or two years before an attempt is made at more intensive forms of farming. In all cases the heavy liming of the soil is essential to the best crop production.

In the more southern group of the Atlantic seaboard States considerable areas of Swamp have been drained and diked and prepared for flooding, so that rice may be grown. Usually a dike is thrown up around the outer margin of the area, particularly in case it is adjacent to tidewater or to a tidewater estuary. In the construction of this dike a ditch is usually dug on the side toward the fields. This constitutes a main ditch into which other lateral drains, from 50 to 100 feet apart, are led. At different intervals a gate is placed in the dike to permit the water to pass out at low tide and to hold the fresh water back for flooding purposes.

The finest quality of rice is being produced upon this alluvial Swamp of the South Atlantic coast. The yields range from 40 to 65 bushels per acre. Many thousands of acres of Swamp in former years cleared, diked, drained, and used for rice cultivation have been permitted to fall into disuse during the last 25 or 30 years. With increase in the price of rice and with the demand for it as a great American cereal crop, it is probable that hundreds of thousands of acres of excellent rice land, along the coast of the Carolinas and of Georgia, might be utilized again for the growing of this crop.

Very few areas of Swamp of any large extent have been cleared and cultivated in the Northeastern States or in the North Central States. In some instances where such lands occur adjacent to the larger manufacturing cities small areas have been cleared and cultivated to market garden crops. These crops have usually been cabbage, celery, onions, and potatoes. Sufficient progress has been made in this line to prove conclusively that there are, near the densely populated sections surrounding the manufacturing cities of the Northeastern States, thousands of acres capable of complete

reclamation by drainage which can be utilized for the production of a considerable proportion of the daily supply of vegetables required in these cities. When it is also considered that the sanitary surroundings of these cities and towns would be considerably improved through the drainage of these swamps, it is a matter of wonder that larger areas have not already been cleared and utilized.

The greater proportion of the swampy lands of the North Central States consists of marshes which were treeless, grass-grown prairies in the early days of the settlement of this portion of the country. Practically all of the large areas of such land have already been drained and utilized for agriculture. It is well to mention, however, in the consideration of swamp land, that thousands of miles of tile drain have been laid through these marshes of the North Central States, converting them into solid tillable soil of the highest fertility, capable of producing from 60 to 80 bushels of corn per acre, from 40 to 60 bushels of oats per acre, and from $1\frac{1}{2}$ to 3 tons of hay. In fact, many areas which are shown upon the old county maps of these States as swamp-land areas now constitute some of the best and most productive farms of the region. These swamps, which existed in the past and are now tilled lands, constitute an excellent example of what might be done with the remaining marshes of the North Central and Northern States. There is no known instance of any drainage project for the reclamation of these lands, that was well planned and the estimate carefully made, showing any loss to those who undertook the work. In the majority of cases the profits derived have been considerable.

The Tidal marsh along the Atlantic and Gulf coast still remains largely undrained and unutilized for agricultural production. The tidal meadows in southwestern New Jersey and their reclamation were described in the circular on "Meadow." There are many other areas of Tidal marsh of considerable extent, from the New England coast southward, which are utilized to a small extent for agricultural purposes. This utilization is accomplished without diking or drainage. The coarse grasses which grow upon the Tidal marsh have a considerable value for the pasturing of cattle and are even cut for hay. Within the New England States and in some portions along the coast in New York, New Jersey, and Maryland the salt-grass hay, commonly known as "bent hay," is worth about $5 a ton, delivered at shipping points.

Thousands of acres of the Tidal marsh along the Atlantic and Gulf coast may be reclaimed for intensive farming when the demand for land is sufficiently great to justify the expense involved. Before it is possible to use them for the more intensive forms of agriculture, it will be necessary, after the embankment and drainage

have been completed, to permit the annual rainfall thoroughly to wash the excessive salts from the soil.

It is apparent from this discussion of Marsh, Tidal marsh, and Swamp that millions of acres of extremely valuable and fertile soil are in such a condition of excessive moisture that they are at the present time of little or of no use for agriculture. It is also apparent from the reclamation work which has already been undertaken with these different classes of wet land, that a considerable profit is derived from every well-ordered attempt at drainage and reclamation. It is a matter of considerable importance not only to the individual but to the community within which these different swampy soils occur that careful consideration be given to their drainage. In the first place, it is desirable to add a large acreage of extremely fertile soil to the land area of the United States. In the second place, it is usually very desirable that the wet areas should be drained for sanitary reasons.

It is probable that until cheaper and more easily drained upland soils are much more thoroughly occupied than they have yet been in many parts of the United States, many areas of Marsh and Swamp will remain undrained and unutilized. This arises from the fact that the most easily subdued soil will first be utilized. It is well to call attention, however, to the fact that these more difficultly managed soils are frequently of higher acreage value when reclaimed than the more easily subdued upland soils, and that their cultivation under intensive methods of agriculture produces greater profits per acre.

One of the chief reasons why swamp-land areas have not been more generally drained arises from the fact of the high acreage cost of their embankment and drainage. This frequently places the reclamation of such land out of the power of the individual owner who is possessed of but small capital. In consequence, it has frequently been found necessary in those States which have adopted a policy leading to the reclamation of swamp land, to draw special laws enabling the citizens of the State to form drainage districts or companies, which may act in a cooperative way to secure the drainage and reclamation of the land. In this way a high initial expense is distributed over a large number of acres of land, and the capital required is raised through subscription or the assessment of the individual owners in proportion to the amount of land benefited by the drainage reclamation.

SUMMARY.

It is probable that there exists within the eastern United States more than 60 million acres of the different classes of undrained land which are permanently wet.

These lands are classed as Marsh, i. e., fresh water, treeless swamps; Tidal marsh, or treeless swamp, inundated by brackish or saline tidewater; and Swamp, the term used in the soil survey to designate timbered, fresh-water swamps.

The first necessity in the agricultural utilization of such areas consists in the drainage of the land. In the case of the Marsh and Swamp this is usually accomplished by the digging of main-line ditches and laterals, supplemented by the tile underdrainage of the intervening fields. In the case of Tidal marsh it is also necessary to construct embankments against the encroachment of the tide and to establish automatic gates that permit of the outflow of fresh water and prevent the inflow of the rising tide water.

The character of the surface soil and subsoil in the different classes of these permanently wet lands and in the different areas of each class varies considerably. In general, however, it is well charged with organic matter and may be even mucky or peaty. The subsoil may range from a coarse gray sand to a sandy loam, silt loam, or silty clay. Usually subsoil colors are drab, gray, or blue through lack of drainage, and the absence of aeration and oxidation of the iron salts of the mineral portion of subsoil.

In the reclamation of these soils it is necessary to consider, first, their possible agricultural uses when reclaimed; second, the feasibility of the drainage operations involved; third, the probable acreage value of the land when reclaimed. It is then necessary to consider each particular drainage project as an engineering problem by itself, since the different factors which control the cost of drainage are those which will largely control the value of the land and the profit to be derived from its reclamation.

Only small areas of Marsh or Swamp have been reclaimed in the majority of the Eastern States. It has been found, however, particularly in the Middle Atlantic States, that such reclaimed land constitutes excellent soil for the production of corn, cotton, and hay, while a few areas of Tidal marsh along the lower portions of the chief rivers emptying into the Atlantic Ocean are also embanked and drained for the production of a high quality of rice.

Extensive areas of Marsh and Swamp in the central prairie States have long been drained and utilized for agriculture. They constitute some of the most fertile and productive of the corn, oat, wheat, and grass soils of that section.

Approved.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *May 25, 1912.*

APPENDIX.

The following table shows the extent of the Marsh and Swamp in the areas which have been surveyed to this time. In the first column is stated the particular soil survey in which the areas were encountered, in the second column the extent in acres, and in the third column the volume of the Field Operations of the Bureau of Soils in which the report upon the area may be found. Those desiring a detailed description of the soils and of the general conditions which surround them in any particular area may consult these volumes in almost any public library.

AREAS OF MARSH ENCOUNTERED IN THE SOIL SURVEY.

Survey	Area of soil.	Date.[1]	Survey	Area of soil.	Date.[1]
Florida:	*Acres.*		New York:	*Acres*	
Escambia County	448	1906	Monroe County	3,648	1910
Jefferson County	5,504	1907	Washington County	2,880	1909
Louisiana: Tangipahoa Parish	3,072	1905	Wisconsin: Bayfield area	4,928	1910
Michigan: Munising area	704	1904			

AREAS OF TIDAL MARSH ENCOUNTERED IN THE SOIL SURVEY.

Alabama:			Mississippi: Scranton area	34,240	1909
Baldwin County	6,656	1909	New York: Long Island area [3]	16,448	1903
Mobile County	9,024	1909		36,352	
Delaware: Dover area [2]	30,784	1903	North Carolina: New Hanover County [2]	5,888	1906
Florida: Jacksonville area	1,600	1910	Rhode Island: State [2]	4,224	1904
Georgia:			South Carolina:		
Chatham County	79,296	1911	Charleston area [2]	77,312	1904
Glynn County	67,776	1911	Georgetown County	20,544	1911
Louisiana:			Texas: Brazoria area [2]	31,168	1902
New Orleans area [2]	5,504	1903	Virginia: Yorktown area [2]	21,568	1905
Iberia Parish	99,968	1911			
Maryland:					
Anne Arundel County	640	1909			
Easton area	15,616	1907			
Worcester County [2]	23,936	1903			

AREAS OF SWAMP ENCOUNTERED IN THE SOIL SURVEY.

Alabama:			Georgia:		
Autauga County	3,840	1908	Bulloch County	93,504	1910
Baldwin County	31,680	1909	Chatham County	25,472	1911
Dallas County	8,192	1905	Columbia County	1,664	1911
Henry County	30,720	1908	Glynn County	18,112	1911
Mobile County	102,016	1911	Pike County	19,328	1909
Tuscaloosa County	384	1911	Sumter County	13,056	1910
Arkansas: Miller County	2,240	1903	Thomas County	3,328	1908
Connecticut: Connecticut Valley area [4]	39,686	1903	Tift County	6,976	1909
			Waycross area	26,944	1906
Delaware: Dover area	3,712	1903	Indiana: Newton County	3,648	1905
Florida:			Louisiana:		
Jacksonville area	16,000	1910	Acadia Parish	1,728	1903
Jefferson County	54,400	1907	Caddo Parish	11,200	1906
Marianna area	54,208	1909	De Soto Parish	2,048	1904
Leon County	2,816	1905	Iberia Parish	19,776	1911

[1] Year of publication, Field Operations.
[2] Mapped as Galveston clay.
[3] Mapped as Galveston sandy loam and Galveston clay.
[4] Mapped as Connecticut swamp.

AREAS OF SWAMP ENCOUNTERED IN THE SOIL SURVEY—Continued.

Survey.	Area of soil.	Date.[1]
Maryland:	*Acres.*	
Calvert County	3,600	1900
St. Marys County	2,200	1900
Worcester County	26,048	1903
Michigan:		
Pontiac area	704	1903
Saginaw area	1,344	1904
Mississippi:		
Crystal Springs area	3,072	1905
Scranton area	37,056	1909
New York:		
Binghamton area	1,024	1905
Livingston County	1,920	1908
Syracuse area	12,480	1903
North Carolina:		
Chowan County	15,104	1906
Craven area	188,288	1903
Duplin County	109,824	1905
Edgecombe County	23,424	1907
New Hanover County	14,464	1906
Pasquotank and Perquimans Counties	57,536	1905
Pitt County	51,328	1909
North Carolina—Continued.	*Acres.*	
Raleigh to Newbern area [2]	12,410	1900
Richmond County	15,296	1911
Robeson County	108,800	1908
Scotland County	28,480	1909
Pennsylvania: Center County	2,176	1908
Rhode Island: State	27,008	1904
South Carolina:		
Clarendon County	120,576	1910
Conway area	88,000	1909
Darlington area	14,144	1902
Georgetown County	28,736	1911
Lee County	27,904	1907
Orangeburg area	40,448	1904
Sumter County	35,136	1907
Virginia:		
Chesterfield County	2,432	1906
Hanover County	6,208	1905
Norfolk area	12,928	1903
Yorktown area	26,368	1905
Texas: Bastrop County	320	1907
Vermont and New York: Vergennes area	2,048	1904

[1] Year of publication, Field Operations.

[2] Mapped as Pocoson and Savanna.

ADDITIONAL COPIES of this publication may be procured from the SUPERINTENDENT OF DOCUMENTS, Government Printing Office, Washington, D. C., at 5 cents per copy